

AMENDMENTS TO THE CLAIMS

1-28. (Canceled)

29. (Currently Amended) A standard model creating apparatus for creating a standard model which shows an acoustic characteristic having a specific attribute and is used for speech recognition in an electronic apparatus used by a user, the standard model creating apparatus using a probability model that expresses a frequency parameter showing an acoustic characteristic as an output probability, the standard model creating apparatus comprising:

a reference model storing unit configured to store a plurality of reference models which are probability models showing an acoustic characteristic having a specific attribute; and

a standard model creating unit configured to create the standard model by calculating statistics of the standard model using statistics of the plurality of reference models stored in said reference model storing unit,

wherein said standard model creating unit includes:

a standard model structure determining unit configured to determine a structure of the standard model which is to be created, based on specification information regarding specifications of the electronic apparatus;

an initial standard model creating unit configured to determine initial values of the statistics specifying the standard model whose structure has been determined; and

a statistics estimating unit configured to estimate and calculate the statistics of the standard model so as to maximize or locally maximize a probability or a likelihood of the standard model, whose initial values have been determined, with respect to the plurality of reference models,

wherein the plurality of reference models and the standard model are expressed using at least one Gaussian distribution, and

said standard model structure determining unit is configured to determine a number of statistics of the standard model including at least a number of Gaussian mixture distributions as the structure of the standard model,

said standard model structure determining unit is configured to determine a Gaussian mixture distribution having an Mf (Mf > 1) number of mixture distributions as the structure of the standard model, and

said statistics estimating unit is configured to calculate at least one of a mixture weighting coefficient $\omega_{f(m)}$ ($m = 1, 2, \dots, M_f$), a mean value $\mu_{f(m)}$ ($m = 1, 2, \dots, M_f$), and a variance $\sigma_{f(m)}^2$ ($m = 1, 2, \dots, M_f$) which are the

statistics of the standard model $\sum_{m=1}^{M_f} \omega_{f(m)} f(x; \mu_{f(m)}, \sigma_{f(m)}^2)$ (where

$f(x; \mu_{f(m)}, \sigma_{f(m)}^2)$ ($m = 1, 2, \dots, M_f$) represents a Gaussian distribution, and x represents input data) represented by the Gaussian mixture distribution so as to maximize or locally maximize a likelihood

$$\log P = \sum_{l=1}^{N_g} \int_{-\infty}^{\infty} \log \left\{ \sum_{m=1}^{M_f} \omega_{f(m)} f(x; \mu_{f(m)}, \sigma_{f(m)}^2) \right\} \left\{ \sum_{l=1}^{L_{g(l)}} v_{g(l,l)} g(x; \mu_{g(l,l)}, \sigma_{g(l,l)}^2) \right\} dx$$

of the standard model, with respect to Ng (Ng ≥ 2) reference models

$$\sum_{l=1}^{L_{g(l)}} v_{g(l,l)} g(x; \mu_{g(l,l)}, \sigma_{g(l,l)}^2) \quad (l = 1, 2, \dots, N_g) \quad (\text{where}$$

$g(x; \mu_{g(l,l)}, \sigma_{g(l,l)}^2)$ ($i = 1, 2, \dots, N_g, l = 1, 2, \dots, L_{(l)}$) represents a Gaussian distribution,

$L_{g(l)}$ ($i = 1, 2, \dots, N_g$) represents a mixture distribution of each of the reference models,

$v_{g(l,l)}$ ($l = 1, 2, \dots, L_{g(l)}$) represents a mixture weighting coefficient,

$\mu_{g(l,l)}$ ($l = 1, 2, \dots, L_{g(l)}$) represents a mean value, and

$\sigma_{g(l,l)}^2$ ($l = 1, 2, \dots, L_{g(l)}$) represents a variance).

30. (Previously Presented) The standard model creating apparatus according to claim 29,

wherein the specification information indicates at least one of a type of an application program running on the electronic apparatus, and specifications of the electronic apparatus.

31. **(Cancelled)**

32. **(Previously Presented)** The standard model creating apparatus according to claim 29, further comprising:

a specification information holding unit configured to store an application/specifications correspondence database showing a correspondence between an application program which uses the standard model and specifications of the standard model,

wherein said standard model structure determining unit is configured to read specifications corresponding to an application program to be activated from the application/specifications correspondence database held by said specification information holding unit, and to determine the structure of the standard model based on the read specifications.

33. **(Previously Presented)** The standard model creating apparatus according to claim 29, further comprising:

a specification information creating unit configured to create the specification information,

wherein said standard model structure determining unit is configured to determine the structure of the standard model based on the created specification information.

34. **(Previously Presented)** The standard model creating apparatus according to claim 29, wherein the standard model creating apparatus is connected to a terminal apparatus via a communication channel, and further comprises:

a specification information receiving unit configured to receive the specification information from the terminal apparatus,

wherein said standard model structure determining unit is configured to determine the structure of the standard model based on the received specification information.

35-45. (Canceled)

46. (Currently Amended) A method of creating a standard model which shows an acoustic characteristic having a specific attribute and is used for speech recognition in an electronic apparatus used by a user, the method using a probability model that expresses a frequency parameter showing an acoustic characteristic as an output probability, the method comprising:

a reference model reading step of reading plurality of reference models from a reference model storing unit which is configured to store a plurality of reference models which are probability models showing an acoustic characteristic having a specific attribute; and

a standard model creating step of creating the standard model by calculating statistics of the standard model using statistics of the plurality of reference models that has been read,

wherein the standard model creating step includes:

a standard model structure determining sub-step of determining a structure of the standard model which is to be created, based on specification information regarding specifications of the electronic apparatus;

an initial standard model creating sub-step of determining initial values of the statistics specifying the standard model whose structure has been determined; and

a statistics estimating sub-step of estimating and calculating the statistics of the standard model so as to maximize or locally maximize a probability or a likelihood of the standard model, whose initial values have been determined, with respect to plurality of reference models,

wherein the plurality of reference models and the standard model are expressed using at least one Gaussian distribution, and

said standard model structure determining unit is configured to determine a number of statistics of the standard model including at least a number of Gaussian

mixture distributions as the structure of the standard model,

said standard model structure determining unit is configured to determine a Gaussian mixture distribution having an Mf (Mf ≥ 1) number of mixture distributions as the structure of the standard model, and

said statistics estimating unit is configured to calculate at least one of a mixture weighting coefficient $\omega_{f(m)}$ ($m = 1, 2, \dots, M_f$), a mean value $\mu_{f(m)}$ ($m = 1, 2, \dots, M_f$), and a variance $\sigma_{f(m)}^2$ ($m = 1, 2, \dots, M_f$) which are the

statistics of the standard model $\sum_{m=1}^{M_f} \omega_{f(m)} f(x; \mu_{f(m)}, \sigma_{f(m)}^2)$ (where

$f(x; \mu_{f(m)}, \sigma_{f(m)}^2)$ ($m = 1, 2, \dots, M_f$) represents a Gaussian distribution, and x represents input data) represented by the Gaussian mixture distribution so as to maximize or locally maximize a likelihood

$$\log P = \sum_{l=1}^{N_g} \int_{-\infty}^{\infty} \log \left[\sum_{m=1}^{M_f} \omega_{f(m)} f(x; \mu_{f(m)}, \sigma_{f(m)}^2) \right] \left\{ \sum_{j=1}^{L_{g(l)}} v_{g(i,j)} g(x; \mu_{g(i,j)}, \sigma_{g(i,j)}^2) \right\} dx$$

of the standard model, with respect to Ng ($Ng \geqq 2$) reference models

$\sum_{l=1}^{L_{g(i)}} v_{g(i,l)} g(x; \mu_{g(i,l)}, \sigma_{g(i,l)}^2)$ ($i = 1, 2, \dots, N_g$) represents a Gaussian distribution.

$L_{g(i)}$ ($i = 1, 2, \dots, N_g$) represents a mixture distribution of each of the reference models,

$v_{g(i,l)}$ ($i = 1, 2, \dots, N_g$, $l = 1, 2, \dots, L_{g(i)}$) represents a mixture weighting coefficient,

$\mu_{g(i,l)}$ ($i = 1, 2, \dots, N_g$, $l = 1, 2, \dots, L_{g(i)}$) represents a mean value, and

$\sigma_{g(i,l)}^2$ ($i = 1, 2, \dots, N_g$, $l = 1, 2, \dots, L_{g(i)}$) represents a variance).

47. (Currently Amended) A program stored on a computer-readable medium which when executed causes a standard model creating apparatus to perform steps for creating a standard model which shows an acoustic characteristic having a specific attribute and is

used for speech recognition in an electronic apparatus used by a user, the program using a probability model that expresses a frequency parameter showing an acoustic characteristic as an output probability, the steps comprising:

a reference model reading step of reading plurality of reference models from a reference model storing unit which is configured to store a plurality of reference models which are probability models showing an acoustic characteristic having a specific attribute; and

a standard model creating step of creating the standard model by calculating statistics of the standard model using statistics of the plurality of reference models that has been read,

wherein the standard model creating step includes:

a standard model structure determining sub-step configured to determine a structure of the standard model which is to be created, based on specification information regarding specifications of the electronic apparatus;

an initial standard model creating sub-step of determining initial values of the statistics specifying the standard model whose structure has been determined; and

a statistics estimating sub-step of estimating and calculating the statistics of the standard model so as to maximize or locally maximize a probability or a likelihood of the standard model, whose initial values have been determined, with respect to the plurality of reference models

wherein the plurality of reference models and the standard model are expressed using at least one Gaussian distribution, and

said standard model structure determining unit is configured to determine a number of statistics of the standard model including at least a number of Gaussian mixture distributions as the structure of the standard model,

said standard model structure determining unit is configured to determine a Gaussian mixture distribution having an Mf ($M_f \geq 1$) number of mixture distributions as the structure of the standard model, and

said statistics estimating unit is configured to calculate at least one of a mixture weighting coefficient $\omega_{f(m)}$ ($m = 1, 2, \dots, M_f$), a mean

value $\mu_{f(m)}$ ($m = 1, 2, \dots, M_f$), and a variance $\sigma_{f(m)}^2$ ($m = 1, 2, \dots, M_f$) which are the

statistics of the standard model $\sum_{m=1}^{M_f} \omega_{f(m)} f(x; \mu_{f(m)}, \sigma_{f(m)}^2)$ (where

$f(x; \mu_{f(m)}, \sigma_{f(m)}^2)$ ($m = 1, 2, \dots, M_f$)

represents a Gaussian distribution, and x represents input data) represented by the Gaussian mixture distribution so as to maximize or locally maximize a likelihood

$$\log P = \sum_{l=1}^{N_g} \int_{-\infty}^{\infty} \log \left(\sum_{m=1}^{M_f} \omega_{f(m)} f(x; \mu_{f(m)}, \sigma_{f(m)}^2) \right) \left\{ \sum_{j=1}^{L_{g(l)}} v_{g(l,j)} g(x; \mu_{g(l,j)}, \sigma_{g(l,j)}^2) \right\} dx$$

of the standard model, with respect to N_g ($N_g \geqq 2$) reference models

$$\sum_{l=1}^{L_{g(l)}} v_{g(l,j)} g(x; \mu_{g(l,j)}, \sigma_{g(l,j)}^2) \quad (l = 1, 2, \dots, N_g) \quad (\text{where}$$

$g(x; \mu_{g(l,j)}, \sigma_{g(l,j)}^2)$ ($i = 1, 2, \dots, N_g, l = 1, 2, \dots, L_{g(l)}$) represents a Gaussian distribution,

$L_{g(l)}$ ($i = 1, 2, \dots, N_g$) represents a mixture distribution of each of the reference models,

$v_{g(l,j)}$ ($l = 1, 2, \dots, L_{g(l)}$) represents a mixture weighting coefficient,

$\mu_{g(l,j)}$ ($l = 1, 2, \dots, L_{g(l)}$) represents a mean value, and

$\sigma_{g(l,j)}^2$ ($l = 1, 2, \dots, L_{g(l)}$) represents a variance).

48-58. (Cancelled)

59. (Previously Presented) The standard model creating apparatus according to claim 33,

wherein said specification information creating unit is configured to create the specification information with an N1 number of the Gaussian distributions when an instruction that the electronic apparatus is to perform quick speech recognition is obtained from the user, and to create the specification information with an N2 ($> N_1$) number of the Gaussian distributions when an instruction that the electronic apparatus is

to perform precise speech recognition is obtained from the user, and

 said standard model structure determining unit is configured to determine the
 number of the Gaussian mixture distributions according to the specification information
 created by said specification information creating unit.

60. **(Cancelled)**